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Quantifying the effective seismic anisotropy produced by a ridge-transform model

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Global tomographic models depict long-wavelength azimuthal anisotropy in the oceanic upper mantle, with a fast axis direction orthogonal to divergent plate boundaries. This anisotropy is usually attributed to the Lattice Preferred Orientation (LPO) of olivine due to asthenospheric mantle flow away from the ridge axis. In this work, we want to test an alternative hypothesis, whether this observed anisotropic signal could be partially explained by the presence of transform faults and associated fracture zones in the lithosphere. The transform plate boundaries represent sharp structures perpendicular to the ridge-axis with the wavelength (˜10 km), which is much smaller than the wavelength of seismic surface waves used to image the mantle (˜100 km). Therefore, transform faults could potentially result in an effective anisotropy in tomographic images through their Shape Preferred Orientation (SPO). We base our calculations on several thermo-chemical models that follow the observed ridge-transform geometry at different spreading rates. To produce the effective medium as seen by long-period waves, we use a non-periodic homogenization algorithm. The resulting seismic velocity field can be interpreted as the tomographic image that would be obtained after inverting long-period seismic data; it is smooth, fully anisotropic, and comparable to actual tomographic models.